Research Proposal of the Thesis Entitled

Quality Tools implementation and Quality Level achievement-

A Study of Supply Chain of Automobile Industry in Pune

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1. Introduction

Quality is one of the oldest theme or need that is being used for last few thousand years. In the earlier days, the quality of the stone axe was important for survival. As the humankind progressed to newer generation the meaning and requirement of quality changed but the very existence of the quality remained. In the modern days, the quality has taken the position of the most important need of anything that one does. Now a days, quality has not remained attached to a product and has spread across all aspects of business or household work.

Similarly, the Quality tool is almost as old as the term quality. During the stone-age the quality of the sharpness of axe was checked by moving thumb over the edge. The feel was the quality tool then. The use of modern Quality Tools is very recent; if you compare the growth of humankind; and is just nearing a century now.As a strong pillar of business, it has become the core of the business excellencesince 1990s. Though it is reason for success for many, mainly the Original Equipment Manufacturers (OE or OEM), the use of Quality Tools, at the Tier 1 industry is far from ideal and the Quality Managers and owners grapple with the selection of tools. Either they are overwhelmed by the high-endQuality Tools, or they use low end tools or tools suggested by the OEMs just for the sake of compliance. This ends up into waste of resources.

Some of the business institutions like Confederation of Indian Industry (CII), or governments make efforts for the suppliers to use right quality approach by conducting trainings, seminars on the Quality Systems, use of Quality Toolsand also by conducting Business Excellence competitions. The CII Business-Excellence-Award, Golden-Peacock Quality-Awards in

Indiaand European Foundation Quality Model (EFQM), Malcolm Baldridge Awards in western countries or Deming Award in Japan are all efforts to make the Quality and Quality Tools an acceptable way of achieving excellence.

In India, the automotive industry is the one that has used Quality Tools very effectively. If the Indian car manufacturers have stood strong against the global competition, the major reason to make this happen is that they embraced quality and Quality Tools very effectively. They used these tools to bring in the "Step Improvement" in last couple of decades. The Indian OEMs as well as Foreign manufacturers like Suzuki, Toyota, and VW ensured that the tools are passed down to the Tier I and Tier II suppliers. However, the transfer is not very efficient and there are many suppliers who are using tools just because these are being asked by the OEMs. It was more of a compelling reason rather than an inner drive. In the process, many suppliers started using high end tools which they really do not need. Another aspect of this is how well these tools have been implemented across the organizations. At the same time there are cases mainly in Tier II and Tier III suppliers where the use of tool is very elementary.

It is a well-known fact that the focus on Quality is different in different regions. In specific region of India, the focus is to just satisfy the OEs or just ensure good marks in the audits by the OES. Whereas in some states, the suppliers have a very high focus on quality irrespective of the pressure from the OEMs.The suppliers in Delhi regions have certain approach towards quality, if you go to Kolkata, there is another totally different approach. Go to Chennai, Bengaluru and then they have their own way that is visible in 200 km radius. Thus, if one wants to study the Quality Tools, it would be good if the study is restricted to a city or regions. Pune one of the key automobile hubs in India has its own vibes, and that is what is part of the study.

The effort in this thesis is to explain what all tools are used by the suppliers and how effectively these are being used. The thesis will make an attempt to understand which tools

are good for the purpose and help the manufacturers to choose the tools wisely. This study is limited to Pune region.

2. Review of Literature

To understand how the various authors have looked at the Quality Tools, its usage, excellence, and application the author referred multiple papers and theses published and could get a lot of insight on these aspects as mentioned below.

In research by Kulkarni (2017) it is mentioned that the organizations she studied, are having a good understating of the Total Quality Management (TQM) principles in both manufacturing and service industries and it has helped in developing the companies to achieve increasing level of performance. TQM as per her, helps achieve business leadership by engaging and inspiring teams and by having customer sensitive responses. Similarly, Kumar (2020) took reference from a Six Sigma program in one prominent foundry in Agra to improve the quality of the casting and reduced rejection. He found that Six Sigma tool is very effective in studying the effect of multiple factors in the foundry and how it helps in improving the quality and that delivers as side effects the increased productivity, cost reduction and reduction in pollution level. At the end he said this approach helped in survival of foundry industry in Agra. He highly recommends the use of six sigma tool for quality improvement. Ramkumar(2020) on the other hand conducted systematic research on use of Lean Six Sigma to improve the quality level of the Small and Mid-Size Enterprises (SME). He found that the use of Critical Success Factors (CSF) itself is a process that leads the Six Sigma exercise. In the study he found that the teams were able to do generate decisive knowledge on the process, issues, and possible solutions. With Lean Six Sigma, the team was able to improve on the quality level by 20% and cost reduction by equivalent amount. This was a clear study on the extent of improvement achieved by using a high-end quality tool.

There was good work done on TQM. Like, Suryyanarayana (2011)who tried to study the use of TQM in Indian industries. His research was based on the application of TQM and allied Quality Tools. However, his study has limited coverage on how the tools were able to improve the quality level. It was more on how the management or users perceive the tools and he conclude that the implementation of the TQM has a long way to go in making it a sustainable quality methodology. Then, Mani(2008) studied TQM is a different perspective classical and contemporary and found that the current TQM efforts are practitioner oriented or a Quality Guru oriented and has worked on some 40 element factors and tried to provide new TQM principle as a concept and not as a total package. Overall, again the study was about the structure of the quality methodology and not much is mentioned on the effect of those.Moballeghi (2007) in his study on TQM compared multiple companies on the extent to which the TQM culture was adopted. His work was to find out what helps effective implementation of TQM and he concluded that top management support, long terms orientation and persistence, customer orientation, employee involvement and training were important factor on implementation and sustainability of TQM process. However, how far it helps in improving the quality level was not much defined in his work.

Then there were studies on the basic quality systems like Quality Management Systems (QMS) likeInternational Organization of Standardization's ISO 9001 and Standardization of Technical Specification's TS16949. For example,Jebarani(2007)work was basically about how QMS was employed in export-oriented manufacturing industries and had little to say about the effectiveness of the same in terms of the quality level or the improvements achieved in other business aspects.Similarly, work by Balsare(2014)was mainly focused on industry in and around Pune. It is based on the Quality Certification – ISO 9001 – 2008 and focuses mainly on the HRS aspect. It gives a different perspective of the Quality System

usage but does not really give a lot of benefit to the study of Quality Tools. On the other hand, Mathuradas (2011) conducted detailed research on the quality practices and performance. In his study he covered Quality Certifications (ISO 9001), Total Quality Management (TQM) and has gone even farther to include the Business Excellence Model (BE) Certifications and to study the effect of these on the performance. He found that there is significant correlation between performance and the quality practices adopted by the organization. Whereas he commented that ISO 9001 though is a hygiene factor, its length of existence in the organizations is not correlated to the performance, however doing away with it is not recommended. He also tried to correlate the relationship between having ISO 9001 certification before TQM implementation and before Business Excellence efforts and concluded that ISO 9001 does not aid in anyway in increasing the performance of TQM or BE. It's a big revelation that ISO needs to take account and do major grounds up change to help industry get benefit out of certification. His work related to the size of the organization, age of organization, technology set up also tried to relate to quality performance, but this is not in the interest of the topic here. This study however does not speak a lot on the quality levels keeping this important aspect of performance ignored.

Kumar (1990) studied very elementary attempts on the shop floors in the form of Quality Control Circles or simply Quality Circles (QC or Q.C. or QCC) as an attempt to improve on the day-to-day issues observed by the worker. His work throws good light on the movement of involving the frontline workers in issue resolution. 6 years of existence of the QC Circles was studied for this purpose from the Rourkela Steel Industry. He commented that the 94% of the suggestions were implemented and that speaks volume about the quality of the outcome. However, he has not much emphasized on the Quality Improvement Potential of these Q.C.Circles which is a major deliverable of this attempt. Dasgupta(2011) made similar effort to study the Q. C. Circle movement in Kolkata. He observed that the QC Circle movement

though beneficial is having varied level of implementation and results. His work was more on the organized attempt rather than the outcome.

In his study, Desai (2019) tried to establish effect of four Quality Tools used in TQM on the product quality in radio frequency domain. The tools used were Poka Yoke or Mistake Proofing, House of Quality (also called as Quality Function Deployment or QFD), Scatter diagram and Design of Experiments (DoE or DOE). These are some high-end tools and gives a good perspective about how these would be affecting the quality of the product. He found out that the House of Quality (QFD) is a first step to understand the requirement of the customer and helps in defining right specification of the product that would suit the customer, is more a design tool rather than a quality improvement tools. Scatter diagram is a good tool to ensure the quality of the product over the lifetime by using regression analysis in tandem with the scatter plot. Poka-Yoke is an effective tool to eliminate or avoid defect or give advance warning to the user or maker about the failure and that could help in minimizing the defects. Design of Experiment he says is used effectively to improve the quality once it gets up to a particular level. It uses the available data, works around it, and gives breakthroughs in breaking the status quo in the quality levels. Overall, he found these tools extremely important.

In an attempt to study a relatively new philosophy, Kulkarni (2006) in his research on the use of Six Sigma on the performance of manufacturing sector in Pune confirmed that Six Sigma can provide high magnitude and sustainable results irrespective of type and size of the industry. The motivating factors to adopt the six-sigma methodology definitely is the improved level of quality but it gives cost reduction and customer satisfaction as added benefits. The focus of the companies moves from quality to cost reduction to customer satisfaction as they keep achieving the intended goals. He concluded his thesis with the guideline which speaks about achieving accuracy (quality), speed and agility to face the next

level of business in the digital era.Similarly,Srinivasan (2016) in his research on use of Define – Measure – Analyse – Improve and Control (DMAIC) way of Six Sigma implementation and how it helped in achieving global quality levels by systematic use of the tool. He found that compared to the conventional tools Six Sigma which is an improvement philosophy can yield you unfathomable depths in the quality improvements. The exercise gave results like 31,000 DPMO reduced to 1,500 and 780,000 to dead zero achieving six sigma level of quality. This was against the backdrop of multiple tools being used earlier that has given results nowhere near to 6 Sigma and were able to go max to 3.5 sigma which by any standard was mediocre level. He recommended use of Six Sigma methodology of DMAIC to achieve World Class levels of Quality and defines this as the premier tool for quality improvements.

Similar to Six Sigma there were studies conducted on Lean; and Prasad (2020) in his research has studied the effect of Lean Manufacturing. He worked on the Pump Mfg. Industry related to Induction motor manufacturing. He tries to study how the tool help in quality and quantity but ends speaking more about the quantity. So, this leaves a gap to study the effect of Lean Manufacturing in Quality.

More advanced tools too were studied by some authors like Shanmugaraja (2014) who worked on a novel concept of using QFD and tool invented in Russia called Teoriya Resheniya Izobretatelskikh Zadach(TRIZ)or Theory of Inventive Problem Solving in English. It was a successful effort to extend the Six Sigma beyond the known boundaries by unifying to high end Quality Tools that was never done before to form what the researcher called a Total Performance Excellence (TPE) model. This helped the organizations to achieve expected level of service quality, productivity, and efficiency. He concluded that the TPE method resulted in productivity in the manufacturing industry and customer satisfaction in the service industry. The outcome provided reduced rejection of defect rate in manufacturing

Industry while the equivalent effect in the service industry was in the form of reduced customer complaint. Which means this fusion of high-end tools provides desirable results in the quality, which reduced the rejection up to 99% & enable rejection monitoring from percentage to Parts per Million (PPM).

Research Gap

The research done by various authors and scholars was focussed on a Quality Tool or a small group of related Quality Tools. Some other researchers were focussed on Quality Philosophies like TQM or Six Sigma or the supporting methodologies like Total Productive Maintenance (TPM). However, study of Quality Tools as a whole and its application and benefits and which Quality Tools fits best in the situation is not done. There is no study at all on rating quality tools on the basis of its usefulness. The scholarly documents also lag a study to guide on which tool to be used in which situation.

3. Problem Definition

To understand how the Quality Tools are considered in terms of its usefulness by the Quality Managers of the Automotive Industry by assigning some measure to it and study how "Level of Quality Tools' Implementation" affects Quality Level, in the supply chain - of Automobile Industry - in Pune.

4. Research Questions

1. What are the Quality Tools used in Automotive Ancillary Industry?
2. Is there any method to rate those?
3. Is there any priority of use of the tools?
4. Do Quality Tools exhibit a relation to the quality of the product?
5. Are there categories of tools that have significantly different behaviour on the quality of the product than other category of Quality Tools?

5. Need and Significance of Study

If a study reveals the effect of Quality Tools usage on the quality level, it would be of huge benefits to the manufacturing industry. This research wants to understand how the manufacturers have used the tools and how it has helped them. A differentiating level of usage and a possible gap because of this, would help the supplier use right tools wisely. This research will make the Quality Tools selection more efficient from efforts and expenses terms.

6. Research Objectives

1. To understand if Quality Tools have any influence on the quality of the products.
2. To know if the basic age-old tools still significant.
3. To confirm if the high end tools are significant in terms of the outcome.
4. To know why the line inspection by quality inspector still in use and if it really add value.
5. To understand-if mistake proofing is a quality tool and if it is having any significant impact.
6. To understand if the use of quality tool's has any correlation on the quality of the products.

7. Hypothesis of the Study

The study will consider following theories or questions or hypotheses in context of the Quality Tools used in Automotive Industry in and around Pune

1. How Quality Tools and its level of execution affect the quality of the product measured in terms of rejection?

2. Understand if age old tools like 7 QC tools or the "Trial and Error" still useful in today's world of high-end IT based tools.

3. Can one say, companies not using high end tools like Design of Experiment (DoE), and high-end quality systems and principles like TQM, Total Productive Maintenance (TPM) Six sigma and the one using these have significantly different quality levels
4. To conclude if line inspection has any significance in the quality level.
5. Understand if Mistake proofing is a significant tool for quality improvement.
6. Establish correlation between the quality level and the use of Quality Tools, if any and if it could be expressed in terms of an equation for the industry under study.

Hypothesis 1:

H0: There is no relationship between the level of Quality Tools and the quality of the product.

H1: The level of Quality Tools is having impact of the level of the quality of the product.

Hypothesis 2:

H0: Historically used basic Quality Tools does not have any effect of the quality of the product.

H1: Historically used basic Quality Tools affect quality of the product.

Hypothesis 3:

H0: There is no significant difference in level of quality of the companies that use high end tools and the ones that don't.

H1: There is a significant difference in level of quality of the companies that use high end tools and the ones that don't.

Hypothesis 4:

H0: Line inspection does not have any impact on the quality of the product.

H1: Line inspection has any impact on the quality of the product.

Hypothesis 5:

H0: Poka Yoke is not a tool that makes significant impact on the quality.

H1: Poka Yoke is a tool that makes significant impact on the quality.

8. Research Methodology

i. **Research vision:** Study how uses of Quality Tools affect quality.

ii. **Research objective:** To understand how the use of Quality Tools affects the overall quality levels, as the industry matures in use of high-end tools by getting answers to the research questions and fulfil the 5 objectives previously shared in the document.

iii. **Priority area of research:** Study of use of Quality Tools in the suppliers in Pune supplying parts to the Automobile OE manufacturers - An attempt to underline need to use the Quality Tools.

iv. **Research scope:** Understand relation between use of Quality Tools and the quality of the products or components manufactured by the suppliers in Pune.

v. **Research Method:**

a. Group the Quality Tools in the category of simple to use (and possibly giving low hanging fruits kind of benefits) to most difficult to use (providing cutting edge in issue resolution or quality attainment).

b. Find out which tools or group of tools the suppliers are using.

c. Find out what is the quality level of the suppliers in the form of in-house rework, rejection, and customer rejection.

d. The relation might be established by having the maturity of the Quality Tools getting used in the company and the Parts Per Million (PPM) value of rework or rejection.

e. For this a scale needs to be made that will define the maturity of organization in using Quality Tools. PPM is a linear scale so is simple scale from 0 to 1,000,000.

vi. Sampling method: Survey method - Get information from the Automotive Components Manufacturer's Association (ACMA) and arranges the names in the ascending order of the names. Divide the suppliers in two clusters; one based on the items manufactured (casting, forging, machining, plastic, sheet metal etc.) and another cluster based on the turnover. Next use cluster sampling method with random sampling so that 10% of the total population or 100 suppliers whichever is higher are selected. The number is small as there are not many Tier 1 suppliers in Pune and not all are willing to share confidential data.

vii. Analysis: Data will be analysed and if appropriate the regression tool would be used for analysis of the rejection and the quality tool level. Two sample t-test would be used to understand if there is any significance difference between the two samples taken based on the tools selected and based on the differentiating level of implementation of the Quality Tools.

9. Visible Research Outcomes

1. The relation between extent of use of Quality Tools and product quality will be checked by the outcome.
2. Significance of the basic Quality Tools and age-old practice of on line inspection will be established through the outcome.
3. The outcome will conclude if it makes sense for companies to heavily invest in high end tools like Design of Experiments, Six Sigma approach or Total Quality Management methodology.
4. The outcome will check how Quality Tools and level of implementation affect rejection levels.
5. The outcome will confirm the need for mistake proofing as a quality tool.

10. Tentative Chapter Plan

1. Title
2. Certificate
3. Abstract

Chapter 1: Introduction to Quality Tools

Chapter 2: Literature review

(1) Introduction to the Automobile Industry in Pune and its supplier base

(2) Classification of Quality Tools

(3) The population of the supplier under consideration and classification and selection criteria for studies

Chapter 3: Measurement scale to unify the Level of Quality Tools and Implementation

Chapter 4: Research Methodology

Chapter 5: Data collection and data stratification

Chapter 6: Data Analysis

Chapter 7: Findings

Chapter 8: Results

Chapter 9: Conclusion

Chapter 10: Future Scope

Chapter 11: References

4. Appendices
5. Glossary
6. List of Publication during Ph. D. Course
7. List of presentation during Ph.D. course.

11. Scope and Limitations of the Study

11.1 Scope of Study

The scope of the study is limited to suppliers of automobile industry in Pune region.

The suppliers with special processes like Electricals and Electronics are not considered.

Study is also limited to Tier 1 suppliers with few tier 2 suppliers which have significant size.

11.2 Limitations of study

Due to business constraints and fear of leakage of information leading to of use of data by competition, many of the suppliers have requested anonymity, which has been maintained. Owing to the same reason many suppliers have declined to respond. This has led to further reducing the number of responses.

The study is based on the responses by the competent authority and critical questioning was done to understand more about the Hypotheses. However, the figures are not challenged. Hence the study is as good as the responses received by the author.

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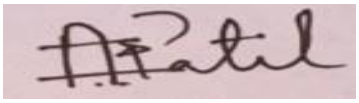

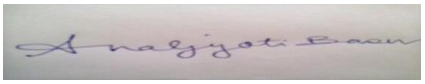

Signature of Research Scholar **Signature of Supervisor/Co-Supervisor**